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United States General Accounting Office

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Briefing Report to the Chairman, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, U.S. Senate

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January 1988

COMPLETED

FAA TECHNICAL CENTER

Mission and Role in National Airspace System Plan Implementation

GAO/IMTEC-88-6BR

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Information Management and
Technology Division

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January 6, 1988

The Honorable Frank R. Lautenberg
Chairman, Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
United States Senate

Dear Mr. Chairman:

As requested in your letter of January 29, 1987, we conducted a survey of the mission and operations of the Federal Aviation Administration's (FAA) Technical Center located in Pomona, New Jersey.

You noted in your request letter that FAA has proceeded to production with several high-cost systems in its $15 billion National Airspace System plan without adequately testing and validating their operational capability. You also noted that FAA has invested substantial resources in its Technical Center and asked us to survey the overall mission of the Center, its role in modernizing the air traffic control system (implementing the National Airspace System plan), and the way in which the Center allocates and uses resources.

As agreed with your office, we performed a broad survey of the Technical Center and developed information on its mission, organization, and staffing. We also focused survey work on the Center's roles and responsibilities, and its allocation of resources in developing, testing, and deploying systems in the National Airspace System plan. (See appendix I.)

The primary mission of the Technical Center is to provide the test facilities, skills, and services necessary to support the development, testing, and evaluation of equipment, systems, procedures, and processes used in the National Airspace System. On a day-to-day basis the Center's work primarily revolves around (1) modernization of the air traffic control system, (2) maintenance of operational automation systems, and (3) research into aircraft safety and aviation security.

With regard to modernizing the air traffic control system, the Technical Center performs a full range of functional tasks supporting design, development, production, procurement, and testing and evaluation throughout the system development process. With regard to maintenance of operational automation systems, the Technical Center modifies

and maintains all air traffic control hardware and software systems. In the area of aircraft safety and aviation security, the Center exercises program management responsibility for research that supports FAA's regulatory process.

Details on the level of Center resources associated with its different work efforts were discussed when we briefed your office on the results of our survey on June 30, 1987. As requested, this briefing report summarizes the information presented during that meeting. (See appendix II.)

As requested by your office, we did not obtain official agency comments. However, we discussed the data in this briefing report with FAA officials and their comments have been incorporated as appropriate. As arranged with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the date of this letter. At that time we will send copies to the Secretary of Transportation, the FAA Administrator, and other interested parties. If you have any questions about this briefing report, please call me on 275-4649.

Sincerely yours,

Carl R. Palmer
Associate Director

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Abbreviations

FAA	Federal Aviation Administration
GAO	General Accounting Office
IMTEC	Information Management and Technology Division
NAS	National Airspace System

Objectives, Scope, and Methodology

On January 29, 1987, the Chairman, Subcommittee on Transportation and Related Agencies, Senate Committee on Appropriations, requested that we survey the overall mission of the FAA Technical Center and identify the role it plays in the implementation of the National Airspace System (NAS) plan. In discussions with the Chairman's office, we agreed to develop information on the Center's mission, responsibilities, organizational structure, and allocation and utilization of resources with emphasis on the Center's role in developing, testing, and deploying systems in the NAS plan.

To obtain the information requested by the Chairman, we reviewed pertinent documents and interviewed key officials at:

- The Office of the Associate Administrator for Development and Logistics—FAA Headquarters, Washington, D.C.
- FAA Technical Center, Pomona, New Jersey
- Major FAA contractors involved in NAS program implementation, including Martin Marietta Corporation and MITRE Corporation.

Our survey was performed in accordance with generally accepted government auditing standards. Our audit work was conducted between March and June 1987.

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Briefing on FAA Technical Center

CHART II.1

SURVEY OBJECTIVES

-- DETERMINE OVERALL MISSION OF FAA TECHNICAL CENTER

-- DETERMINE HOW TECHNICAL CENTER RESOURCES ARE ALLOCATED AND UTILIZED

-- IDENTIFY TECHNICAL CENTER'S ROLE IN IMPLEMENTING THE NATIONAL AIRSPACE SYSTEM MODERNIZATION PLAN

Survey Objectives

We performed a broad-based survey of the operations of the FAA Technical Center.

We developed information covering mission, organization, and funding of the Technical Center, as well as staff and laboratory resources available to it. We also developed information on the Center's test and evaluation responsibilities and its role in implementing the NAS plan.

CHART II.2

FAA TECHNICAL CENTER

MISSION

-- OPERATE A NATIONAL TEST CENTER PROVIDING LABORATORIES, SKILLS, AND SERVICES RESPONSIVE TO RESEARCH, DEVELOPMENT, IMPLEMENTATION, AND MAINTENANCE OF FAA PROGRAMS

-- DEVELOP, TEST, AND EVALUATE NEW EQUIPMENT, SYSTEMS, MATERIALS, PROCESSES, AND PROCEDURES

-- PERFORM AND PARTICIPATE IN RESEARCH, ENGINEERING, AND DEVELOPMENT OF PROJECTS RELATED TO:

- NATIONAL AIRSPACE SYSTEM
- AIRCRAFT SAFETY/AVIATION SECURITY SYSTEMS
- AIRPORTS

Mission

Technical Center officials advised us that the Center's day-to-day technical work efforts primarily revolve around:

- modernizing the air traffic control system (NAS plan implementation), including engineering and development support;
- maintaining the present NAS automation systems (field support to operational sites); and
- researching aircraft safety and aviation security issues.

With regard to NAS plan implementation, the Technical Center performs a full range of functional tasks supporting the development, test, and evaluation process.

More details on these work efforts and the Technical Center's test and evaluation responsibilities are provided in charts II.10, II.10A, and II.15.

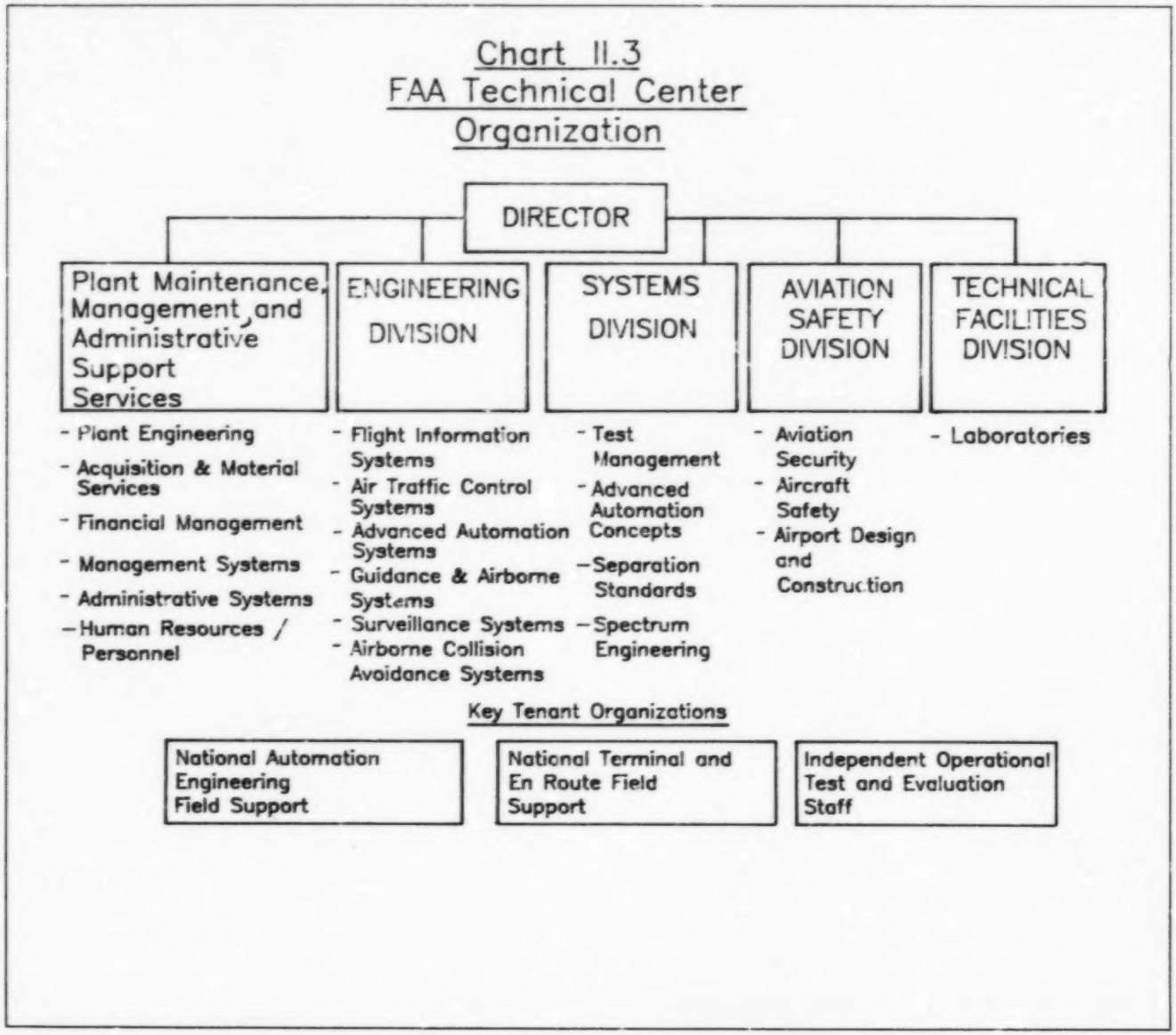
Chart II.3
FAA Technical Center
Organization
DIRECTOR
Plant Maintenance, Management, and Administrative Support Services
ENGINEERING DIVISION
SYSTEMS DIVISION
AVIATION SAFETY DIVISION
TECHNICAL FACILITIES DIVISION
- Plant Engineering
- Acquisition & Material Services
- Financial Management
- Management Systems
- Administrative Systems
- Human Resources / Personnel
- Flight Information Systems
- Air Traffic Control Systems
- Advanced Automation Systems
- Guidance & Airborne Systems
- Surveillance Systems
- Airborne Collision Avoidance Systems
- Test Management
- Advanced Automation Concepts
- Separation Standards
- Spectrum Engineering
- Aviation Security
- Aircraft Safety
- Airport Design and Construction
- Laboratories
Key Tenant Organizations
National Automation Engineering Field Support
National Terminal and En Route Field Support
Independent Operational Test and Evaluation Staff

Organization

The Technical Center is one of four organizations under the Associate Administrator for Development and Logistics. This Associate Administrator is also responsible for the overall implementation of the NAS plan. The other three organizations under the Associate Administrator are:

- Systems Engineering Service—responsible for advanced concept studies and technology development for application in future NAS programs.
- Program Engineering and Maintenance Service—responsible for development, acquisition, production, and installation of all air traffic control equipments and systems, except for programs under the Advanced Automated Program Office.
- Advanced Automation Program Office—responsible for development, acquisition, production, and installation of the Host Computer System, Advanced Automation System, Voice Switching Control System, and Automated En Route Air Traffic Control System.

In addition to plant maintenance, management, and administrative support services, the Technical Center has four operating divisions, as follows:

- Engineering Division—the Center's focal point to support development and implementation of the NAS plan. Responsibilities include engineering support, and equipment and software test support.
- Systems Division—the Center's focal point for advanced automation concepts technology. Also supports development and validation of test requirements for accomplishment of test and evaluation of NAS plan systems.
- Aviation Safety Division—the Center's program management Division for research in aircraft safety and aviation security. Also, supports work on airport design and construction.
- Technical Facilities Division—the Center's management for maintaining and operating the laboratories.

Key Tenant Organizations

In addition to its four operating divisions, the Technical Center has three key tenant organizations:

National Automation Engineering Field Support maintains the current air traffic control hardware as well as diagnostic and support software.

National Terminal and En Route Field Support maintains all current air traffic control decision making software. It also tests and evaluates new NAS plan software enhancements before field implementation.

Independent Operational Test and Evaluation Staff performs FAA's independent operational tests and evaluations for NAS plan major system acquisitions.

Although these tenant organizations do not report directly to the Center, they are funded and administered by the Center. For purposes of our survey, we considered their functions and resources to be an integral part of the Center.

The Center also has other tenant organizations that we did not include in our survey because they are not funded or administered by the Center. These tenants include:

- an FAA aircraft maintenance base,
- a flight inspection field office,
- a station of the National Weather Service, and
- a small contingent of the FAA Eastern Region Airway Facilities Sector Field Office.

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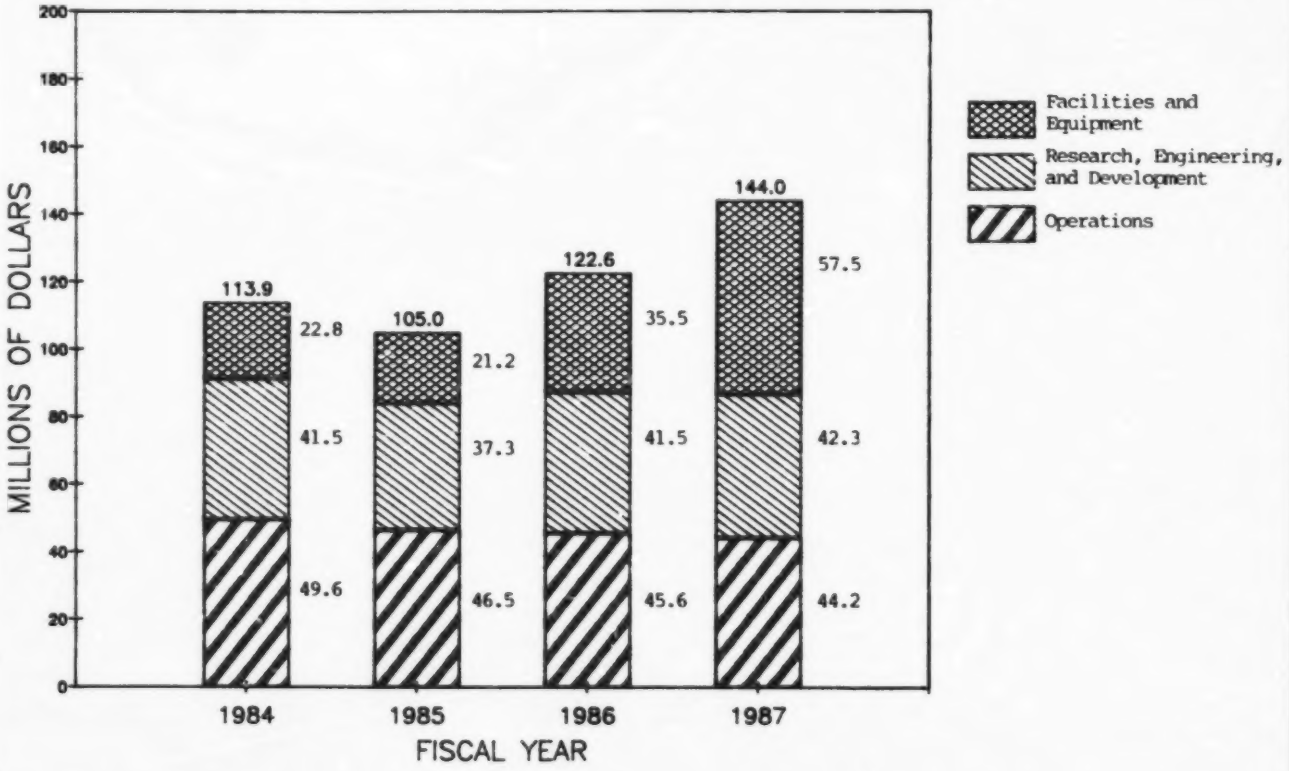
Chart II.4
FAA Technical Center
Appropriation History, 1984–1987



Appropriation History

The Technical Center is funded under three appropriations:

- Facilities and Equipment, used for implementation of NAS plan projects.
- Research Engineering and Development, used for research and development to improve the air traffic control system.
- Operations, used to operate and maintain the air traffic control system and provide administrative support.

Except for a slight decrease in 1985, as compared to 1984, overall funding of the Center has increased from about $114 million in 1984 to about $144 million for 1987. When FAA first announced its NAS plan in 1982, the Center received a $85.4 million appropriation.

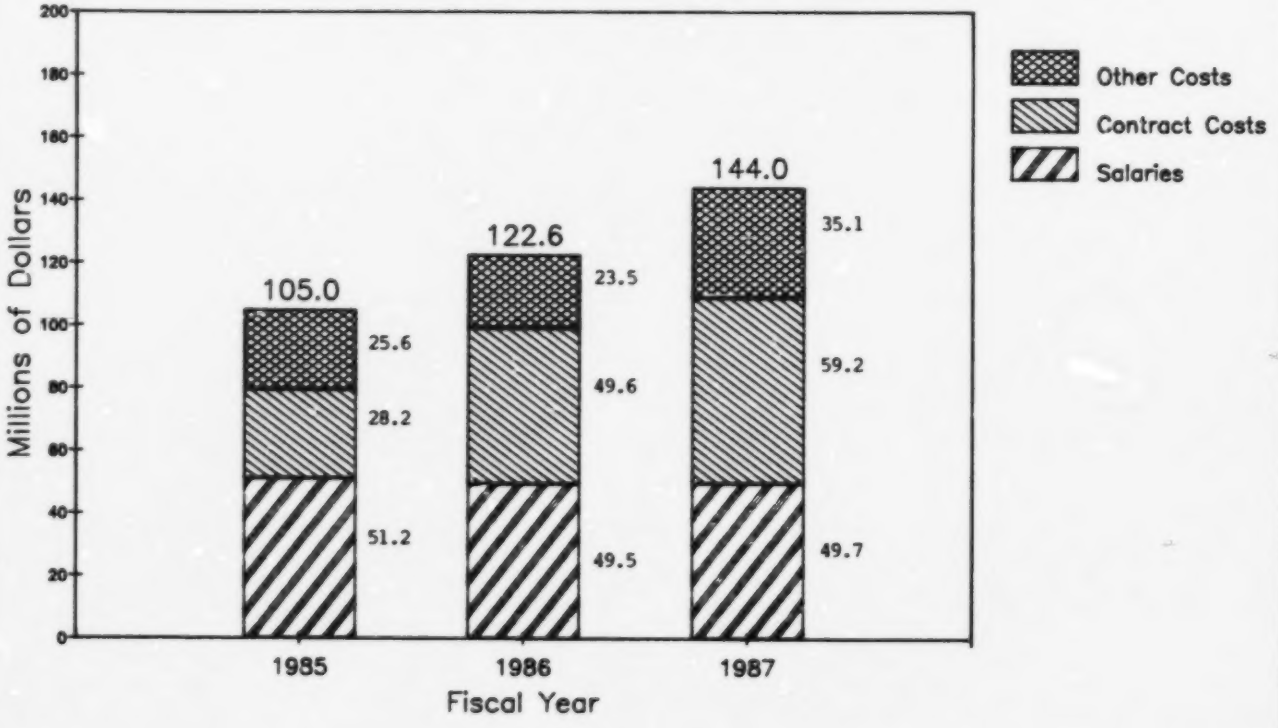
The Center's facilities and equipment appropriation has generally accounted for the rise in funding. Center officials said its increased facilities and equipment funding results from the evolution of the NAS plan from its initial phase of design and development toward actual production and delivery of systems and equipments. By the end of fiscal year 1987, more than 90 percent of the NAS plan will be under contract. The evolution of the NAS plan into its production phase, together with a new NAS plan test and evaluation policy (described in chart II.14) will lead to an increased Center test and evaluation role.

Over the last 4 years, the Center's research engineering and development and its operations appropriations have remained relatively constant.

Technical Center Portion of Total FAA Appropriations

For fiscal year 1987, the Center expects to receive 5 percent of FAA's facilities and equipment appropriation, 26 percent of FAA's research engineering and development appropriation, and 2 percent of FAA's operations appropriation. This level of funding represents about 3 percent of total FAA appropriations.

Chart II.5
FAA Technical Center Funding Distribution, Salaries, Contract Costs, and Other Costs: 1985, 1986, and 1987

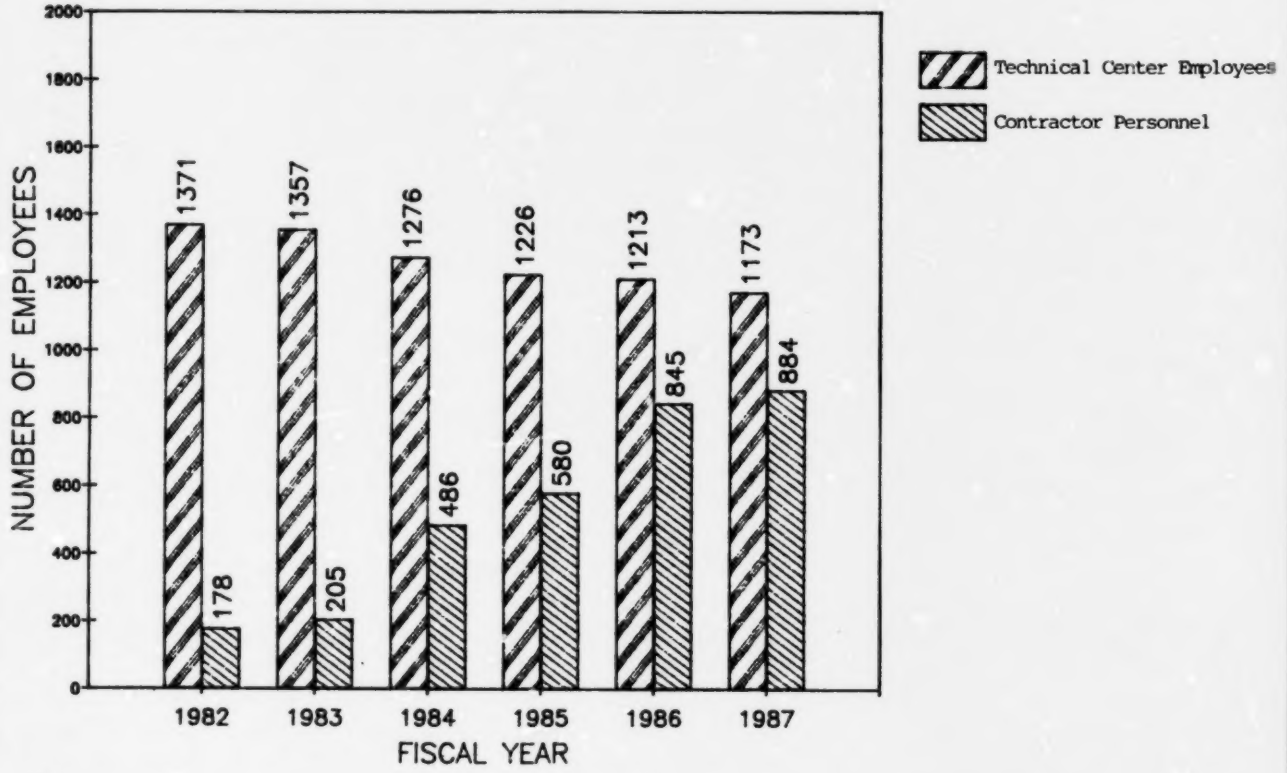


Funding Distribution, Salaries, Contract Costs, and Other Costs

Technical Center funds are primarily used for employee salaries and contractual services. In fiscal years 1985, 1986, and 1987 these two categories accounted for about 75 to 80 percent of total expenditures. The remaining funds are for such costs as travel, rent, utilities, supplies, and materials.

Over the same fiscal years, the Center has experienced a trend toward increased funding for contractual services as compared to salaries. For example, funding for salaries remained relatively constant at about $50 million, but its percentage of total funding has decreased from 49 percent in 1985 to 35 percent in 1987. Funding for contractual services has risen from about $28 million, or 27 percent of total funding in 1985, to about $59 million or 41 percent of total funding in 1987.

Chart II.6
FAA Technical Center Work Force Trend
1982–1987



Technical Center Workforce Trend

Between 1982 and 1987 there has been a gradual decrease in the number of Technical Center employees. During the same period, the number of contractor personnel has quadrupled.

Center officials advised us that the trend towards reliance on contractor personnel will probably continue and possibly increase in the future. They said they believe any future expanded Center work, such as NAS plan system integration test and evaluation activities and Automated En Route Air Traffic Control system program manager responsibilities, will most likely be accomplished by contractors as opposed to new, in-house staff. Center officials said it is easier to obtain funding for contract services than to obtain authorization for additional employees.

Of the 1,173 Center employees in fiscal year 1987, 870 are in technical positions. This number represents close to a one-for-one ratio of Center employees to contractor technical skills.

Center contractor personnel include (1) contractors developing specific NAS plan systems, and (2) contractors providing support to the Center in the areas of data analysis, engineering, and software services. NAS plan development contractors include companies such as International Business Machines, UNISYS Incorporated, Hughes Corporation, and Computer Sciences Corporation. Support contractors include companies such as Martin Marietta Corporation, MITRE Corporation, and RMS Technologies Corporation. Contractor personnel are either physically located at the Center or within 50 miles of it.

Technical Center Positions Being Reviewed to Determine Need for Commercial Versus In-house Support

During our survey, about 250 Technical Center positions from three organizational elements (Technical Facilities Division, National Automation Engineering Field Support, and National Terminal and En Route Field Support) were subject to Office of Management and Budget Circular A-76 reviews.[1] Positions under study include computer system analysts, electronic engineers and technicians, engineering technicians, and computer operators. The process is not expected to be completed until early 1989.

Center officials expressed concern that the A-76 reviews have already had some adverse impact on mission accomplishment, and that loss of

[1]Office of Management and Budget Circular A-76 establishes federal policy for determining whether commercial activities should be operated under contract with commercial sources or in-house using government personnel and facilities. A commercial activity is defined as one that is operated by a federal agency, and provides a product or service that could be obtained from a commercial source.

staff as a result of the A-76 reviews could affect the Center's ability to provide field support to NAS operational sites and support NAS plan implementation. They said the principal effect could be the loss of some key employees who have skills and experience in hardware and software maintenance of older NAS systems. They added that there is concern that these skills are no longer available in the commercial market.

The Associate Administrator for Development and Logistics informed us he is aware of the Center's concern regarding the effect of the A-76 reviews. He said the Technical Center has taken steps to minimize the adverse effects of these reviews. For example, in several cases determinations were made to exempt critical positions scheduled to be included in the A-76 reviews.

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CHART II.7
FAA TECHNICAL CENTER
EMPLOYEE SKILLS

SKILL	NUMBER
TECHNICAL	
-COMPUTER SYSTEM ANALYST	270
-ELECTRONICS ENGINEER	160
-ELECTRONICS TECHNICIAN	50
-MATHEMATICIAN	45
-AIR TRAFFIC CONTROL SPECIALIST	40
-COMPUTER OPERATOR	40
-AEROSPACE ENGINEER	35
-ENGINEERING TECHNICIAN	30
-OPERATIONS RESEARCH ANALYST	30
-OTHER TECHNICAL	170
SUBTOTAL	870
MANAGEMENT AND ADMINISTRATIVE SUPPORT	303
TOTAL	1,173

Technical Center Employee Skills

In fiscal year 1987, the Technical Center employed 1,173 full-time permanent employees. At that time, 870 employees, or almost 75 percent of the work force, held technical positions. Computer system analysts and electronic engineers were the two most prevalent technical skills. Management and administrative support positions comprised the remaining 25 percent.

CHART II.8
FAA TECHNICAL CENTER
LABORATORIES/FACILITIES

LABORATORY	FACILITY
-SYSTEM SUPPORT	-EN ROUTE SYSTEM SUPPORT -TERMINAL SYSTEM SUPPORT -FLIGHT SERVICE/WEATHER FACILITY -GROUND-TO-AIR COMMUNICATION AND NAVIGATION SUPPORT -INTERFACILITY COMMUNICATION -MAINTENANCE AND OPERATIONS
-GENERAL SUPPORT	-AIRCRAFT FIXED WING SYSTEM SUPPORT -AIRCRAFT-ROTORCRAFT SYSTEM SUPPORT -NAVIGATIONAL AIDS SYSTEM SUPPORT -RANGE INSTRUMENTATION -FLIGHT TEST MONITORING -COMMUNICATIONS SUPPORT -GENERAL PURPOSE DATA CENTER -DATA GENERAL SYSTEM SUPPORT
-RESEARCH AND DEVELOPMENT	-NAS SIMULATION SUPPORT
-REGULATORY SUPPORT	-AVIATION SECURITY TEST COMPLEX -ENGINE FUEL TEST COMPLEX -FIRE TEST FACILITY -STRUCTURAL TEST FACILITY -DROP TEST FACILITY -OTHERS (10)

Test Facilities

Technical Center test facilities represent a capital investment of over $100 million and are categorized under four[2] major laboratories as shown in chart II.8.

The purpose of each laboratory is as follows:

- System Support Laboratory—provides development, test and evaluation, and field support capabilities for current and future air traffic control systems.
- General Support Laboratory—provides test, instrumentation, data reduction, and electromagnetic support to the other laboratories that have requirements for use of its airport, airborne, and ground-based facilities.
- Research and Development Laboratory—provides support to the design, development, testing, and evaluation of advanced concepts, procedures, systems, and system modifications proposed for introduction into NAS.
- Regulatory Support Laboratory—provides research and tests of all activities conducted by the aircraft safety program to aid and support certification and safety assessment of the agency.

In summary, the overall purpose of Center laboratories is to provide technical support for: 1) maintaining current NAS systems, 2) testing, evaluating, and integrating new NAS plan systems prior to field issuance, 3) developing advanced air traffic control concepts and technology, and 4) examining aircraft airworthiness, post-crash survival, aviation security, personal safety, and airport technology.

With regard to day-to-day NAS plan implementation, the Center's System Support, General Support, and Research and Development laboratories can be used for three distinctly different test and evaluation functions: operational field support (maintenance testing), systems testing, and integration testing. The laboratories are the heart of the Technical Center. Virtually all the Center's work revolves around the test and evaluation resources contained in the laboratories—in fact, the tenant activities located at the Center are there only because of the laboratories.

[2]In addition to these facilities, but not included as part of the laboratory complex, the Center also houses the central computer system and the interfacility communications network used to operate FAA's Traffic Management System. This system supports FAA's central flow control function. The computer complex is operated by a contingent of FAA Eastern Region personnel and is not considered part of the Center's laboratory complex.

Laboratories/Facilities

As shown on chart II.8, the four laboratories are actually comprised of several different facilities. According to Center officials, the System Support, the General Support, and the Research and Development laboratories collectively house hardware, software, and simulation capability that can test about 90 percent of current NAS operational system requirements. These laboratories will also house test facilities for new NAS plan equipment as it is introduced into the system.

For example, the En Route System Support facility within the System Support laboratory currently contains equipment that replicates operational en route center air traffic control facilities. The En Route System Support Facility has three versions of the 9020 computers, the computer display channel, direct access radar channel, and the new Host Computer System.

Laboratory Capacity

Center laboratory officials informed us that, to date, the laboratories have sufficient capacity to meet all user requirements, and no NAS plan programs have been delayed because of a lack of access to laboratory facilities. Some Center laboratory components operate 24 hours a day, 7 days a week to accommodate all users.

Center laboratory officials said they believe that if the current transition plan for hardware and space requirements progresses according to schedule, the laboratory complex will be adequate to simultaneously support existing as well as future NAS equipment. However, these officials advised us that they do not have contingency plans in the event of major program delays.

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CHART II.9
FAA TECHNICAL CENTER
DAY-TO-DAY WORK EFFORTS AND
FISCAL YEAR 1987 LEVELS OF EFFORT

	FY 1987 LEVEL OF EFFORT (PERCENT)
-MODERNIZATION OF THE AIR TRAFFIC CONTROL SYSTEM (NAS PLAN IMPLEMENTATION)	32
-MAINTENANCE OF THE PRESENT NAS AUTOMATION SYSTEMS (FIELD SUPPORT TO OPERATIONAL SITES)	16
-RESEARCH INTO AIRCRAFT SAFETY AND AVIATION SECURITY	25
-PLANT MAINTENANCE AND MANAGEMENT, AND ADMINISTRATIVE SUPPORT	27
TOTAL	100

Day-to-day Work Efforts—Fiscal Year 1987 Levels of Effort

Technical Center officials grouped their day-to-day work into three primary technical areas: modernization of the air traffic control system—NAS plan implementation; maintenance of the present NAS automation systems—field support to operational sites; and research into aircraft safety and aviation security. In addition, the Center provides for the management and maintenance of plant equipment and facilities as well as administrative support.

For fiscal year 1987, we estimated that the Center will expend about 32 percent of its work effort on modernizing the air traffic control system—NAS plan implementation; about 16 percent on maintaining the present NAS automation systems—field support to operational sites; about 25 percent for research into aircraft safety and aviation security; and about 27 percent for plant maintenance and management, and administrative support. These percentages are based on estimates provided by the Center's division managers as to their day-to-day work efforts, and our analysis of fiscal year 1987 funds to the respective divisions. We included all management and support organizations within the category of plant maintenance and management, and administrative support, and did not prorate any funds for these efforts among the technical work efforts.

Work efforts other than plant maintenance and management, and administrative support are discussed further with charts II.10; II.10A; II.11; and II.12.

The category of plant maintenance and management, and administrative support includes work efforts related to human resources, financial management, acquisition of materials and services, plant engineering, and Center management. This category also includes work related to operation and maintenance of the Atlantic City airport, which is located on Center grounds.

Center officials agreed that our estimates provide a reasonable breakout of their 1987 work efforts.

CHART II.10
FAA TECHNICAL CENTER
WORK EFFORT
MODERNIZATION OF AIR TRAFFIC CONTROL SYSTEM
(NAS PLAN IMPLEMENTATION)

-- TECHNICAL AND OPERATIONAL SUPPORT TO FAA PROGRAM MANAGERS AND FIELD SITES FOR DEVELOPMENT OF NAS PLAN SYSTEMS

-- TEST AND EVALUATION SUPPORT TO ASSURE NAS PLAN PROJECT REQUIREMENTS ARE VERIFIED AND EVALUATED IN A REALISTIC TEST ENVIRONMENT

-- TEST FACILITIES TO SUPPORT NAS PLAN IMPLEMENTATION

-- ON-SITE SUPPORT TO FAA CONTRACTORS

Work Effort—Modernization of Air Traffic Control System (NAS Plan Implementation)

FAA program managers within the System Engineering Service, Program Engineering and Maintenance Service, and Advanced Automation Program Office decide which specific requirements are sent to the Technical Center for NAS plan implementation. Decisions are made by considering the budget process, resources, and work relationships, and are further refined on the basis of continuous negotiations between the Center and program managers. In effect, the Center functions as a project-oriented shop and provides resources for FAA program managers.

Work performed by the Center on NAS plan implementation varies among individual projects, based on task agreements negotiated between the Center and program managers. As a result, the Center works within various NAS plan program areas and performs a full range of functional tasks supporting design, development, production, procurement, and testing and evaluation throughout the life-cycle development process.

In the area of testing and evaluation, the Center plays a key role in NAS plan implementation because of the new NAS plan test and evaluation policy. (More information on the NAS plan test and evaluation policy and the Center's specific responsibilities is contained in charts II.14 and II.15.)

We were advised that in the initial years of the NAS plan, the Center was mostly concerned with supporting program managers in developing procurement specifications and soliciting contractor proposals. Currently, the Center's role deals more with production development including contract monitoring and testing and evaluation. Center officials said they believe the Center is now considered to be an integral part of FAA's team that is responsible for NAS plan implementation. They said that over the last few years, the Center's work has become: 1) more focused around the NAS plan, 2) more accepted and respected by headquarters, and 3) more actively involved in FAA programs than it was prior to 1982 when the NAS plan was initiated. To illustrate the point, Center officials said the Center has been assigned a program management responsibility for the Automated En Route Air Traffic Control II program.

In summarizing the Center's current work efforts relative to NAS plan implementation, Technical Center officials advised us that currently the Center does mostly testing and evaluation, some developmental work, and a little research.

CHART II.10A
FAA TECHNICAL CENTER
TECHNICAL PROGRAMS
SUPPORTING MODERNIZATION OF
THE AIR TRAFFIC CONTROL SYSTEM
(NAS PLAN IMPLEMENTATION)

TECHNICAL PROGRAMS	FISCAL YEAR 1987 FUNDING
EN ROUTE/TERMINAL	
ADVANCED AUTOMATION/SECTOR SUITE	$ 4,758,000
CURRENT EN ROUTE/TERMINAL AUTOMATION	3,192,000
FLIGHT SERVICE	
FLIGHT SERVICE STATION AND WEATHER PROCESSORS	2,247,000
MAINTENANCE PROCESSORS	1,753,000
WEATHER SENSORS	999,000
GROUND-TO-AIR	
DATA LINK	3,154,000
SECONDARY RADAR	2,981,000
LANDING SYSTEMS	2,193,000
NAVIGATION	1,864,000
PRIMARY RADAR	1,237,000
TRAFFIC ALERT COLLISION AVOIDANCE SYSTEM	947,000
AIR GROUND COMMUNICATIONS	768,000
COMMUNICATION PROCESSORS	754,000
INTERFACILITY COMMUNICATIONS	0
AUXILIARY	
POWER SYSTEMS	562,000
STRUCTURES	489,000
COCKPIT TECHNOLOGY	0

Technical Programs Supporting NAS Plan Implementation

The Technical Center performs work under several technical program areas that support NAS plan implementation.[3] Various individual projects are included under these program areas, and specific work efforts vary among projects, based on task agreements reached with FAA program managers.

For example, under the Current En Route/Terminal Automation program, the Center forecasted $3.192 million in fiscal year 1987 expenditures. Included under this program is the New York Terminal Radar Approach Control project, which will expand the air traffic control system at that facility and provide the capability of processing the traffic load forecast from now to the year 2000. For this project the Center has been tasked to support the program manager during all phases of the expansion program, including procurement, installation, testing, and acceptance of new system hardware and software.

The following breakout details the Center's specific work responsibilities for four NAS plan projects.

Table II.1: Work Responsibilities in Four NAS Plan Programs

Technical Program	Project	Technical Center Work Efforts
Current En Route/ Terminal Automation	New York Terminal Radar Approach Control will handle activities of the air traffic control system until the Advanced Automation System is implemented.	Technical support for all phases of expansion: procurement, installation, testing, and acceptance of all new system hardware and software.
Advanced Automation/Sector Suite	Advanced Automation System provides a total automation system that includes the controller sector suite, new computer software, and new processors to augment or replace the Host Computer System.	Support design, development, testing, and implementation of Advanced Automation System; includes (1) monitoring technical contracts, (2) supporting demonstrations and tests, (3) preparing acquisition phase documents, (4) evaluating proposals, (5) defining test requirements, and (6) evaluating test scenario requirements.
Secondary Radar	MODE-S is a cooperative surveillance and communication system, works in conjunction with airborne transponders to obtain information on aircraft identity and altitude, and serves as the basis for digital communication between the ground system and the aircraft.	Technical support to monitor the design, development, fabrication, and test of MODE-S systems being procured, including evaluation of contractor test plans. Design of MODE-S test equipment.
Maintenance Processors	Remote Maintenance Monitoring System provides a monitoring and control system for FAA facilities so that NAS equipment performance monitoring, certification, and control can be accomplished from central locations.	Provision of a wide range of engineering services to support the Remote Maintenance Monitoring System procurements, and establishment and maintenance of a test facility for developing, testing, and evaluating hardware and software as tasked.

[3]In fiscal year 1987, the Center's level of work effort under NAS plan implementation as shown on chart II.9 is broader than work directly under the technical programs shown on chart II.10A. The Center's total NAS plan work effort also includes activities that support the technical programs such as the operation of laboratory facilities.

CHART II.11
FAA TECHNICAL CENTER
WORK EFFORT
MAINTENANCE OF THE PRESENT NAS AUTOMATION SYSTEMS
(FIELD SUPPORT TO OPERATIONAL SITES)

-- TWO TECHNICAL CENTER TENANTS PROVIDE FIELD SUPPORT TO MAINTAIN THE PRESENT NAS HARDWARE AND SOFTWARE AUTOMATION SYSTEMS

-- NATIONAL AUTOMATION ENGINEERING FIELD SUPPORT

-- NATIONAL TERMINAL AND EN ROUTE FIELD SUPPORT

Work Effort—Maintenance of the Present NAS Automation Systems (Field Support to Operational Sites)

The Technical Center's maintenance of the present NAS operational hardware and software automation systems and field support to operational sites is performed by two of its tenant organizations:

- National Automation Engineering Field Support.
- National Terminal and En Route Field Support.

As mentioned previously under the organization structure of the Center, (chart II.3), the National Automation and Engineering Field Support activity is responsible for maintaining all NAS automation hardware and diagnostic and support software.

The National Terminal and En Route Field Support activity is responsible for maintaining and modifying all NAS air traffic control decision-making software. Management officials advised us that they anticipate their future staffing needs will increase significantly as FAA acquires the newer and more complex NAS plan systems.

CHART II.12
FAA TECHNICAL CENTER
WORK EFFORT
RESEARCH INTO AIRCRAFT SAFETY AND AVIATION SECURITY

-- TECHNICAL CENTER HAS PROGRAM MANAGEMENT RESPONSIBILITY FOR AIRCRAFT SAFETY AND AVIATION SECURITY RESEARCH

	FISCAL YEAR 1987	
	FUNDING (Millions $)	PROJECTS
AIRCRAFT SAFETY	10	71
AVIATION SECURITY	13	38

Work Effort—Research Into Aircraft Safety and Aviation Security

The Technical Center's Aviation Safety Division has program management responsibility for performing research in the areas of aircraft safety and aviation security. According to Center officials, FAA is the lead agency for the federal government in aviation security research.

Most program requirements for aircraft safety and aviation security research are generated from the Office of Airworthiness, the Office of Civil Aviation Security, and the Office of Aviation Safety. These offices are outside the Associate Administrator for Development and Logistics organization. This research is primarily used to support FAA's regulatory process (that is, changes and additions to FAA rules). The Aviation Safety Division performs relatively little work on self-generated requirements.

During 1987:

- The Center allocated about $10 million for aircraft safety research into the design and maintenance of criteria to assure airworthiness, reduce occurrences of accidents, and mitigate the effects of in-flight system failures. The Center has a total of 71 research projects underway, including 12 projects on materials, 8 projects on engines, and 6 projects on fuels.
- The Center allocated about $13 million for aviation security for the development of devices to prevent hijacking and sabotage. Research is being conducted in the areas of (1) carry-on luggage, (2) concourse security screening, and (3) in-flight explosives. The Technical Center has a total of 38 research projects underway, including 24 projects for new detection concepts, and 11 projects for concourse security systems.

About 60 percent of the Center's aircraft safety and aviation security work is performed by support contractors.

Funding for the aviation security program is scheduled to decrease from about $13 million in fiscal year 1987 to about $10 million in fiscal year 1988, and less than $6 million per year for fiscal years 1989 through 1992.

CHART II.13
FAA TECHNICAL CENTER
VIEWS OF THE ASSOCIATE ADMINISTRATOR
FOR DEVELOPMENT AND LOGISTICS
ON THE TECHNICAL CENTER

-- THE TECHNICAL CENTER IS A VALUABLE FAA RESOURCE AND WILL CONTINUE TO BE IN THE FUTURE

-- OVER THE NEXT 5 YEARS, THE TECHNICAL CENTER WILL BE PRIMARILY INVOLVED WITH TESTING AND EVALUATION FOR NAS PLAN IMPLEMENTATION

-- THE TECHNICAL CENTER WILL BE PART OF FAA's TRANSITION INTO RESEARCH PROGRAMS BEYOND THE CURRENT NAS PLAN

Headquarters' Views on Role of the Technical Center

The Associate Administrator for Development and Logistics provided us with his views on the role of the Technical Center:

- The Center is a valuable resource that FAA cannot do without. The Center will continue to perform in the same manner in the future, that is, as basically a project-oriented environment, and no major organizational changes are anticipated.
- With the NAS plan entering its production phase, the primary role of the Center for the next 5 years will be testing and evaluation associated with NAS plan implementation. The Center will be responsible for first-site testing of all NAS plan systems including those not sent to the Center's laboratories, for example, the ASR-9 Radar System, which will be tested at the first-site location.
- FAA is in a transition phase with regard to its research programs. Recently, research was directed by the NAS plan. However, over the last few years as the NAS plan has entered its production phase, research has declined agencywide. Research will increase as FAA moves into post-NAS-plan research.
- FAA's research engineering and development funding is projected to increase from $150 million in 1988 to $225 million and then to a $250 million level by 1991-1992. With this increase in mind, the Associate Administrator has recently requested an internal management review of FAA's research process to consider:
  - how research requirements are generated and prioritized, and
  - whether research requirements are responsive to agency needs.

The research role of the Center will be included in this review. It is anticipated that the Center will be part of FAA's future research program efforts.

CHART II.14
FAA TECHNICAL CENTER
NAS PLAN
TEST AND EVALUATION POLICY

-- IN DECEMBER 1986, FAA FORMALIZED A STANDARD TEST AND EVALUATION POLICY FOR ALL NAS PLAN PROJECTS

-- THE NAS PLAN TEST AND EVALUATION POLICY ASSIGNS THE FAA TECHNICAL CENTER A KEY ROLE IN IMPLEMENTING THE NAS PLAN

NAS Plan Test and Evaluation Policy

FAA is about 6 years into implementing acquisitions under its $16 billion NAS plan. First deliveries have been made in nearly half of the 80 projects, 14 projects are completed, and 36 contracts are scheduled for award in the next 2 years. A major factor in timely deployment of the NAS plan will be FAA's ability to perform adequate system testing.

Historically, FAA had a multitude of approaches, terms, and definitions relating to testing, but had no formal policy document addressing all aspects of testing and evaluation. Test and evaluation requirements varied from project to project, based on individual program managers' requirements. Recent reports from the General Accounting Office[4] and an FAA consultant[5] have cited weaknesses in FAA's test and evaluation process and examples where failure to perform this process adequately caused delays in the operational readiness of equipment.

In order to rectify this situation, FAA, in December 1986, formally established a test and evaluation policy governing NAS plan implementation to ensure that adequate testing is accomplished throughout all phases of a project's life cycle. The policy cites the need for preplanning and standardizing the test and evaluation process to preclude the cost and schedule impact of correcting deficiencies after equipment has been phased into operation. The policy also identifies test requirements for the total development and acquisition process and covers all aspects of testing and evaluating, including formulation of test policy, development of test plans and reports, verification of test compliance, and the actual conducting of tests. Currently all NAS plan projects are subject to a single comprehensive test and evaluation policy; those not included must be granted waivers.

NAS Plan Test and Evaluation Policy Implementation

Under the NAS plan test and evaluation policy, specific roles and responsibilities have been officially assigned to the various FAA organizational elements, including several important support roles for the Technical Center.

The Technical Center can be assigned a range of test and evaluation support roles, from initial development to complete system testing on

[4]Aviation Acquisition: Improved Process Needs to Be Followed (GAO/RCED-87-8, March 26, 1987); FAA's Advanced Automation System Acquisition Strategy Is Risky (GAO/IMTEC-86-24, July 8, 1986).

[5]Examination of Testing Activities for Selected FAA Programs (The MITRE Corporation, August 1984).

first-production deliveries. This test and evaluation role is essential to successful NAS plan implementation in that projects can be tested in an operational environment and problems identified and resolved early in the life cycle without affecting day-to-day operations at field sites.

Under the NAS plan policy, NAS interface equipment necessary to establish a system test environment must be available, physically or by electronic means, at the Technical Center to support required testing and evaluation prior to field implementation and to sustain future te tin

The NAS plan test and evaluation policy stipulates that organizations within the Associate Administrator for Development and Logistics organization should issue directives and/or guidelines to implement the policy. As of the time we completed our survey, none of the organizational elements had met this requirement.

With the exception of the Independent Operational Test and Evaluation Staff (chart II.3), which oversees FAA's tests and evaluations for major NAS plan systems, most NAS plan test and evaluation responsibilities are contained within the organization of the Associate Administrator for Development and Logistics.

CHART II.15
FAA TECHNICAL CENTER
NAS PLAN TEST AND EVALUATION
ROLES AND RESPONSIBILITIES

-- TECHNICAL CENTER SUPPORTS ALL ASPECTS OF NAS PLAN TEST AND EVALUATION ACTIVITIES RELATED TO

- DEVELOPMENTAL AND PRODUCTION ACCEPTANCE TESTING
- SYSTEM INTEGRATION TESTING, AND
- OPERATIONAL TESTING

-- FORMAL ESTABLISHMENT OF THE NAS PLAN TEST AND EVALUATION POLICY, TOGETHER WITH THE BEGINNING OF THE NAS PLAN PRODUCTION PHASE, MEANS MORE INVOLVEMENT OF THE TECHNICAL CENTER IN PREDEPLOYMENT NAS INTEGRATION TESTING.

Technical Center NAS Plan Test and Evaluation Roles and Responsibilities

Under the NAS plan test and evaluation policy, the Technical Center can be assigned important but differing roles to support developmental and production acceptance testing, system integration testing, and operational testing.[6] The Center's test and evaluation responsibilities can include developing test policy and plans, reviewing test procedures and monitoring contractor tests, or actually conducting tests. As part of its responsibilities, the Center:

- monitors the installation and checkout of NAS projects delivered to the Center or first field site;
- conducts and/or supports NAS system integration testing on first production delivery and provides support to the program manager for all phases of test and evaluation;
- operates and maintains NAS projects delivered to the Center after FAA acceptance of equipment;
- supports the development of test policy, standards, and test requirements;
- supports the accomplishment of a valid test program by reviewing conformity of test programs with NAS plan test and evaluation policy and standards, by reviewing test plans and procedures, monitoring tests, and reviewing test analyses and reports;
- supports testing activities up to first-site commissioning and may also support additional sites as required;
- supports the operational test and evaluation of NAS projects;
- supports shakedown tests; and
- provides a recommendation based on test results in support of the deployment readiness review process to determine whether a project should or should not be deployed.

[6]For more detailed information, see Test and Evaluation (T&E) Terms and Definitions for the National Airspace System, FAA Publication NAS-MD-110, March 1987.

Increased Involvement of the Technical Center in Testing and Evaluation

The extent of the Center's test and evaluation responsibilities can vary among NAS plan projects based on requirements established by program managers. However, the Center is responsible for testing (either in-house or at a first-site location) first production deliveries of all NAS plan systems to ensure that system requirements—technical performance, interface, and operational—are tested and evaluated in a realistic environment.

Over the next 4 years, 30 NAS plan systems are scheduled for system integration testing at the Center:

- Twelve systems were at the Center for the start of tests on December 31, 1986.
- Five systems are scheduled to be delivered during 1987.
- Thirteen systems are scheduled to be delivered between 1988 and 1991.

A Center official advised us that the Center has recently been asked by FAA headquarters to assume an expanded role in the area of test verification and compliance with the NAS plan test and evaluation policy. This official said that, in the past, the Center supported this function for about 30 projects. The Center has now been asked to perform this function for about 50 projects.

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